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The Effect of The PBL Model with The JAS Approach on Students' Scientific Literacy Skills in The Excretory System Materials

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Abstract

This study was aimed at analyzing the effect of the PBL model with the JAS approach on students' scientific literacy skills in the excretory system materials. The study was conducted at SMA Negeri 2 Semarang in the second semester in the academic year of 2019/2020. The population of this research were the eleven grade science students of SMA Negeri 2 Semarang in the academic year of 2019/2020. The sampling technique used was simple random sampling, in which the class used in this study was randomly chosen by the researcher. In this study, class of XI MIA 3 that consisted of 36 students selected as the control class while XI MIA 2 class with 36 students selected as the experimental class. The research design used on this study was Pretest-Posttest Control Group Design. The data in this study were in the forms of the results of tests of students' scientific literacy skills, observation of students' scientific competencies, the implementation of learning syntax, and students' responses to learning. Independent sample t-test results showed Sig. (2-tailed) < 0.05, it could be meant that there were differences in the ability of scientific literacy between the experimental class and control class after learning. The implementation of learning was equal to 92% that fell into high category. Based on the results of this research, it was able to be concluded that the Problem Based Learning model with the JAS approach affected the ability of students' scientific literacy in the excretion system materials.

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INTRODUCTION

The results of PISA 2018 showed that the Indonesian students' literacy ability need to be improved compared to the students from other countries. Indonesia's science literacy ability reached scores of 396 in the level 1a category (OECD, 2019). Indonesia's science literacy ability left behind in comparation with neighboring countries such as Thailand, Brunei Darussalam, Malaysia and Singapore. There were some factors that affected science literacy skill for a country. Some factors that influenced Indonesian students' PISA results included self-identity and socio-cultural factors (Pakpahan, 2016), teaching materials used (Muhammad, 2018), learning media (Pratiwi & Nurohman, 2018), and the quality of the learning process that had been done (Fatmawati & Utari, 2015).

Efforts to improve the science literacy skills of Indonesian students can be done by considering several of these factors, such as the learning process that is closely related to the model and learning method applied. Based on observations that had been done, the results indicated that the optimal learning process that involves students' active participation has not been achieved yet. The teaching materials was done by the teacher through lecturing and debriefing methods. Limited students' activities during learning process can be a barrier to the fulfillment of the 2013 curriculum.

Various Basic Competencies (KD) of Curriculum 2013 for XI grade require students to be able to analyze diverse systems that exist in the human body. This skill is related to science literacy. One of the materials discussed is the excretion system. Three indicators of aspects of literacy competence are explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting data and scientific evidence that can be obtained in class XI excretion system materials. To fulfill the competency requirements that have to be mastered by the students in the 2013 curriculum, a model and learning method is needed in order to optimally explore students' abilities.

Problem Based Learning (PBL) is a learning model that can be used in reinforcing the 21st century's competencies and is suggested in the implementation of 2013 curriculum in Indonesia. According to Riswari et al. (2018), PBL affects the students' problem-solving skills. Factors that influence problem-solving skill diversities among students who use PBL with conventional class that was because the students who used PBL during learning tend to have more readiness to solve problems (Saputri & Febriani, 2017). PBL also contributes to students' critical thinking skills (Qomariyah, 2016) and can enhance students' creative thinking abilities (Abdurrazak et al., 2016). The application of the PBL model can affect various students' skills because the PBL model is able to conduct a broad learning process through the use of various learning resources, students prepare presentations, arrange reports related to the discussed problems and students get feedback (Barrett, 2017).

Learning resources that can be used to support learning with the PBL model are environmental resource learning. Jelajah Alam Sekitar (JAS) is an approach that involves those who support the environment around the students both the physical, social, technological, and cultural environment as the objects of learning biology with phenomena obtained through scientific work (Alimah & Marianti, 2016). Several studies have shown that JAS research can support 21st century competencies for students. JAS is that method which able to enhance students' critical thinking abilities and student learning outcomes (Julia et al., 2018). Critical thinking ability is an important aspect that closely related to scientific lerning. JAS approach is also able to improve the students' comprehension concepts in learning (Afifah et al., 2017).

Several studies have shown that the PBL model and the JAS approach can influence students' scientific literacy abilities. According to Mundzir et al., (2017) and Adiwiguna et al., (2019), PBL model can improve the scientific literacy ability of elementary school students in learning science. The improvement of scientific literacy with PBL is caused by the students' activities in the learning process. The application of PBL trains students to think critically to solve problems. The research of Fitriani et al., (2017) also showed that the application of PBL models had a significant influence on students' scientific literacy abilities in the reaction rate materials in high school. In addition to learning models that provide opportunities for students to be active in learning, learning resources can also affect students' scientific literacy abilities. Learning with the Jelajah Alam Sekitar can improve the ability of scientific literacy of

junior high school students on the digestive system materials (Santoso et al., 2017). The application of PBL with the JAS approach facilitates students to obtain information and knowledge through a process of exploration of the surrounding environment by involving students as learning subjects.

The application of the PBL model with the JAS approach in learning provides an opportunity for students to explore the environment and link the phenomena that exist in learning with science. Based on previous elaborations, a research is needed to be done in order to analyze the effect of the PBL model with the JAS approach on students' scientific literacy skill.

RESEARCH METHODS

The study was conducted at SMAN 2 Semarang in the second semester in the academic year of 2019/2020. The population of this research were the eleven grade science students of SMA Negeri 2 Semarang in the academic year of 2019/2020. The sampling technique used was simple random sampling, the class used in the study was chosen randomly. In this study, class of XI MIA 3 that consisted of 36 students was selected as the control class while XI MIA 2 class with 36 students was selected as the experimental class. The research design used on this study was Pretest-Posttest Control Group Design. The data in this study were in the forms of the results of tests of students' scientific literacy skills, observation of students' scientific competencies, the implementation of learning syntax, and students' responses to the learning.

Analysis of Science LiteracyAbility Test Result

The results of the students' scientific literacy tests in the form of pretest and posttest scores were analyzed as follows:

$$\text{Science literacy test score} = \frac{\text{number of correct scores}}{\text{maximum number of scores}} \text{ x100}$$

Analysis of Students' Science Competency Observastion Result

The results of students' scientific literacy abilities in which it is in the form of an assessment science competency aspects during the practicum were analyzed as follows:

$$\text{Science competency observation score} = \frac{\text{number of correct scores}}{\text{maximum number of scores}} \text{ x100}$$

Analysis of Learning Implementation Questionnaire

The learning implementation questionnaire is prepared based on the Lesson Plan (RPP). The questionnaire is arranged in the form of a Guttman scale. Analysis of the implementation of planned learning activities can be calculated using the following formula:

$$\text{Implementation Score (100\%)} = \frac{\text{implemented activities}}{\text{total of planned activities}} \text{x100\%}$$

Interpretation of collected scores are presented as follows:

Score (%)	Category
81-100	Very High
61-80	High
41-60	Enough
21-40	Low
0-20	Very low

Calculation of the Students' Test Scores Improvement

To determine the value of improvement of students' test results of science literacy competencies that are collected from the calculation of the deviation between the score of pre-test and post-test, the Normal-Gain formula is used as follows:

$$\text{N-gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}}$$

The interpretation of N-gain value that is achieved, is presented as follows:

Score	Category
(g) ≥ 0,70	High
0,70 (g) > 0,3	Enough
(g) ≤ 0,3	Low

RESULTS AND DISCUSSIONS

The following are the results of this research in the form of tests of students' scientific literacy skills, observing students' competency abilities, the implementation of learning, and students' responses to the learning process at SMA Negeri 2 Semarang.

Science Literacy Ability Test Results

The test instruments used to measure the ability of scientific literacy were arranged in the form of multiple choices. There were 30 questions on the test. The pretest was done before learning the excretion system materials to measure students' initial abilities. Posttests were conducted at the end of learning to compare the results of students' scientific literacy ability tests on the excretory system materials after the learning process. The results of the scientific literacy ability tests of the experimental and control class students are presented in **Table 1**

Table 1 Results of Students' Science Literacy Ability Tests of Excretion Materials of Experiment Class and Control Class

Source of Variation	Eksperimental class		Control class	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Total students	36	36	36	36
The highest score	90	100	76	96
The lowest score	43	70	36	50
The median	60	88	60	76
Average	61,41	87,36	60,13	75,30
Category of average	Enough	Very good	Enough	Good

Based on **Table 1**, the experimental class and control class showed that initial abilities were not much different, with very good and good categories. It indicated that learning PBL with JAS resulted in better scientific literacy skills than conventional learning.

PBL model with the JAS approach enables students to learn comprehensively by using existing problems in the environment as motivation that stimulates students to learn. Existing stimulus makes students try to dig up information with various methods with group members so that independent human learners are formed. The learning process is expected to be able to make students learn in full and comprehensive so that students have the competence to explain phenomena scientifically, evaluate and design scientific enquiry, and interpret data and evidence scientifically according to scientific literacy competencies (OECD, 2019).

The application of PBL with JAS enables students to obtain information from various learning sources such as the internet, direct interviews with experts, and experiences in the field through practical activities. In the learning process, students act as learning subjects who explore and inform science knowledge to others through interviews, experiments with practicums, discussions, presentations, and presentations of work in the form of reports. Learning activities lead students to be active in learning so that students can have scientific literacy competencies that explain phenomena scientifically, evaluate and

design scientific enquiry, and interpret data and evidence scientifically (OECD, 2019). Science learning using problem-based learning can improve the ability of scientific literacy because problem-based learning provides opportunities for students to be directly involved and play an active role in solving a problem that exists in around or in their environment (Mundzir et al., 2017).

To determine the average difference between the experimental class and the control class, an independent sample t-test was conducted with the prerequisites for normality and homogeneity tests. The results of calculations with the help of SPSS 23 are presented in **Table 2**.

Tabel 2 The Results of Normality, Homogeneity, and Independent Sample T-Test Posttest

Class	N	Normality		Homogeneity		T-test	
		Sig.	Decision	Sig.	Decision	Sig.	Decision
Eksperimental	36	0,063	Normal	0,094	Homogenous	0,000	Different
Control	36	0,538	Normal	0,071	Homogenous		

Table 2 T-test results showed Sig. (2-tailed) <0.05 so that H_0 was rejected and H_a was accepted, it meant that there were differences in the ability of scientific literacy between the experimental class and control class after learning. The T-test showed that the scientific literacy ability of students using PBL with JAS was better than conventional learning.

To find out the increase in the scientific literacy ability of the experimental class and control classs, an N-Gain test was conducted. The N-Gain test analysis data is presented in **Table 3**.

Table 3: Results of N-Gain Analysis of Students' Science Literacy Capabilities

Class	Total Students	*N-Gain*	Category
Eksperimental	36	0,7	High
Control	36	0,39	Moderate

The results of the analysis in **Table 3** showed that the N-Gain experimental class and control class had respectively an increase in the high and moderate categories. These results indicated that the improvement of the ability of scientific literacy with PBL learning with JAS was better than conventional learning.

The difference between students' scientific literacy skills in the experimental class was better than the control class because PBL learning with JAS led students to solve problems related to science in everyday life. PBL can significantly improve students 'problem-solving abilities so that the students' academic achievement can increase (Argaw et al., 2017).

Observations of Students' Science Competency Assessment

Assessment of students' scientific literacy skills was not only done by tests, but also based on observations done during the practicums and scientific questions that were related to the laboratory works conducted. The results of competency assessment observations are presented in **Table 4**.

Table 4 Observation Results of Student Science Competency Assessment

No.	Competency	Aspect	Perscentage (%)	
			Experimetal	Control
1.	Evaluating and designing scientific investigations	Preparing urine samples needed	61	66
		Wearing a lab coat	93	84
		Wearing gloves during the laboratory work	88	52
		Constructing the experiment correctly	100	94

2.		Tidying up the equipment and materials after the practical work	95	66
	Interpreting scientific data and evidence	Preparing practical work report	77	44
		Grouping data based on the equation result	66	66
3.		Confirming the result of the experiment obtained to the teacher	22	16
	Interpreting scientific data and evidence	Proposing some reasons to answer the LKS questions	62	22
		Associating with chemical analysis in answering questions	52	29
	Average (%)		71,6	53,9

Based on the results of observations of competency assessment in **Table 4** showed that the scientific literacy competence of students based on observation in the experimental class was better than the control class. Students in the experimental class who used PBL method with JAS approach were accustomed to dealing with science problems related to the excretion system. The problems raised and data found from exploration activities in the experimental class trigger students to be able to interpret the data to develop students' rational thinking skills. The thought process of exploration activities spurs students in analyzing problems, reasoning and deciding on problem-solving solutions (Santoso et al., 2017).

Implementation of Learning-Syntax of PBL Method with JAS Approach

The data of Learning-Syntax Implementation described the learning process of PBL method with JAS approach that had been composed based on the Lesson Plans (RPP). The results of PBL learning with JAS approach is presented on the **Table 5**.

Table 5 Results of PBL Learning with JAS Approach

Sintaks	Statement	'Yes' Answer	Percentage (%)
Orient student to problem	1. The teacher asked an interesting question about hemodialysis technology	34	94
	2. The teacher presented a video of hemodialysis technology	36	100
	3. The teacher provided opportunities for students to respond to questions about hemodialysis	36	100
	4. The teacher asked an interesting question about the process of spending the sweat	33	91
	5. The teacher presented a video on the process of spending the sweat	25	69
	6. The teacher raised interesting problems related to urine tests (are their differences in the composition/urine content of diabetics and normal urine?)	33	91
Organize learning	1. The teacher divided students into groups in the learning process		
Guide individual and group investigation	1. Students were allowed to learn from the internet	36	100
	2. Students were allowed to learn from the environment		
	3. Students performed a urine test practicum in the laboratory	28	77
Develop and present the work	1. The teacher allowed students to present the results of discussion of the problems that existed in the LDS	31	86
		36	100
	2. The teacher allowed students to present the results of the urine content test	35	97
	3. The teacher allowed students to present the results of observations at the health center	29	80

Analyze and evaluate the problem solving process	1. The teacher responded to students' presentations	35	97
	2. The teacher and students together concluded the results of learning at the end of learning	36	100
	3. Students were motivated to learn by having games/quizzes in learning	36	100
	4. Students visited the health center with group members	30	83
	5. Students compiled reflective journals after learning		
	6. Students compiled a urine test practicum report	32	88
	7. Students compiled reports on visits the health center	33	91
		35	97
		36	100
	Average		92
	Category		Very good

Based on **Table 5** showed that the implementation of PBL model learning with the JAS approach in the experimental class was in the very high category. During the learning process of the material system of excretion, the teacher had applied PBL stages namely student orientation to the problem, organizing students to learn, guiding individual/group experiences, developing and presenting the results of analyzing and evaluating the problem-solving process (Nurdyansyah & Fahyuni, 2016). The PBL stage in the learning process is inseparable from the components of JAS, namely exploration, constructivist, science process, learning community, bioedutainment and authentic assessment (Alimah & Marianti, 2016).

Student Responses to PBL Learning with JAS

The data of students' responses regarding PBL learning with JAS was taken after the exclusion system learning process was completed. The results of the analysis of student responses to PBL learning with JAS excretion system material are presented in **Table 6**.

Table 6 Results of Analysis of Students' Responses to PBL Model Learning with JAS Approach

No.	Statement	Score Percentage Answers (%)
1.	I felt happy during the learning process excretion system material	75
2.	I worked with group members during the learning process	82
3.	Learning the excretion system felt interesting so I was passionate about learning	74
4.	I learned excretory system materials by understanding not only just memorizing	77
5.	I learned from problems around the excretion system	77
6.	The learning process carried out made it easy for me to understand the subject matter	72
7.	Learning activities made me gain a lot of experience during the learning process	79
8.	The learning process carried out made it easy for me to remember the subject matter	72
9.	I understood the application of biology in everyday life regarding the excretion system	75
10.	I was more willing to express my opinion	68
11.	I found ideas to answer questions/solve problems that arise during the learning	70
12.	The learning process did not feel boring	67
13.	I was able to explain the scientific phenomena around me related to the excretion system	75

14.	I did not make a mistake that resulted in a work accident in the laboratory at the lab	81
15.	The learning process carried out accordingly was applied to the excretion system materials	81
	Average	75

The results of the analysis of student responses to PBL learning with JAS excretion system material are presented in **Table 6**. The score indicates that the learning process was responded well by the students. Problem-based learning can increase student morale during learning. PBL is also able to shape the independence of students because the learning process involves brainstorming and independent learning (D'sa, 2015). The JAS approach used can spur students' motivation because the students assume the things learned can meet the needs or provide benefits. JAS learning can increase students' enthusiasm during the learning process and students become more focused on learning activities (Salu & Tadius, 2018).

Apart from the positive results outlined earlier, the research conducted still has some shortcomings. Research timing should also be considered so that learning outside the classroom such as in the laboratory runs effectively. The teacher should also provide LKPD (Student Worksheet) as a guide for students to learn independently so that learning objectives are more easily achieved. This study has not been able to compare the results of the application of the Problem Based Learning Model with the JAS approach with the Problem Based Learning Model without the JAS approach to scientific literacy abilities. These limitations can be used as considerations to improve the implementation of further research or as further research materials.

CONCLUSION

Based on the results and discussions that had been carried out, it was concluded that the Problem Based Learning model with the JAS Approach affected the ability of students' scientific literacy in the excretion system materials.

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